AUTOMATED UNMANNED RENTAL SYSTEM AND METHOD

FIELD OF THE INVENTION

This invention relates to rental systems and methods, and more particularly, to an automated unmanned rental system and method.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a schematic/block diagram of an embodiment of an automated unmanned rental system of the present invention.

FIG. 2 shows a schematic layout diagram of an embodiment of an automated unmanned rental station located at an unmanned rental site of the present invention with application in the hotel industry.

FIG. 3 shows a schematic/block diagram of the computer system of FIG. 2.

FIGS. 4A through 4G together form a flow chart that shows a method of an embodiment of a computer system at an automated unmanned rental station of an automated unmanned rental system of the present invention.

FIG. 5 shows a schematic/block diagram of the computer system of a central rental processing center of FIG. 1 incorporating an embodiment of an automated unmanned rental system of the present invention.

FIG. 6 shows a flow chart of a method of a central processing rental center in an embodiment of an automated unmanned rental system of the present invention.

FIG. 7 shows a flow chart of a method of the billing process in an embodiment of an automated unmanned rental system of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a schematic/block diagram of an embodiment of an automated unmanned rental system of the present invention. Referring now to FIG. 1, Automated Unmanned Rental System 100 enables the automatic tracking of rental activity and equipment movement. Automated Unmanned Rental System 100 has a Central Rental Processing Center 102 which is in communication with a number of individual Unmanned Rental Sites 106 through Communications Medium 104. There could be tens or hundreds of Unmanned Rental Sites 106, but only five are shown in FIG. 1 for simplicity. Each Unmanned Rental Site 106 may be geographically located within the same structure, such as a building, within the same city in different buildings or structures, within the same state, within a multiple number of states, or in a number of different countries around the world. Communications Medium 104 may be the Internet, an intranet, a LAN, a WAN, a wireless communication network, a satellite communication network, or any other suitable communications medium. In one embodiment of the invention, Communications Medium 104 is the Internet, and each

Unmanned Rental Site 106 from their different geographic locations are capable of accessing Communications Medium 104, and capable of being accessed by Communications Medium 104, through the Internet.

In another embodiment of the invention, there may be several Central Rental Processing Centers 102 in various geographic regions. For example, each state in the country may have a Central Rental Processing Center 102 having various Unmanned Rental Sites 106 located throughout the state that report to it. Or, several states may be combined into a region with one Central Rental Processing Center 102 responsible for all the Unmanned Rental Sites 106 within the region.

In another embodiment of the Automated Unmanned Rental System 100 of the present invention, each Unmanned Rental Site 106 is self contained and does not need to nor does it communicate with Central Rental Processing Center 102 through Communications Medium 104. Automated Unmanned Rental System 100 is applicable to many different industries that incorporate rental activity in their business. Such industries include, but are not limited to, the hotel industry, the construction industry, the medical industry, and any other industry where Radio Frequency Identification (RFID) tags may be affixed to the rental equipment.

In the construction industry, a tool crib may be established at a construction site by an outside vendor. Typically, an employee of the outside vendor mans the tool crib, checking out

pieces of equipment to workers, and checking them back in. Unless the construction project is extremely large, resulting in fairly heavy usage of the tool crib, manning the tool crib with an employee is very expensive. For smaller construction projects, the tool crib may only be manned for short periods of time throughout the day, which may reduce labor costs, but also has the potential to slow down work on the project for lack of tools when needed. Some construction companies have attempted to operate a tool crib on an honor system, expecting each worker to fill out a check-out sheet for equipment used, and to cross the item off when it is returned. This approach has usually met with little success, due to the nature of the workers and the time constraints and job pressures they work under.

Similarly, in the medical industry, an outside vendor may place various pieces of medical equipment in a manned or unmanned storage room in a medical facility. A manned facility is very expensive, and an unmanned facility, relying on the medical facility employees to follow proper procedure, results in the same types of problems discussed above.

In the hotel industry, especially those hotels that cater to businesses for meetings and events, audio visual equipment may be supplied to the hotel by a third party on a consignment basis. This equipment is typically stored in a storage area accessible by authorized hotel personnel. As hotel clientele request meeting and banquet rooms and supporting audio visual services, hotel personnel retrieve the equipment needed from the

storage area and set it up in the required meeting room or banquet hall. For each such use, the hotel employee is supposed to notify the third party provider or fill out a rental form and submit the rental form to the third party provider, who in turn bills the hotel for the rental of the equipment. The hotel in turn will in most cases bill the guest or business client who requested the audio visual equipment in the first place.

The inherent and obvious difficulty with this process is that it relies completely on the honesty and reliability of the hotel staff. In situations like this, many uses of the audio visual equipment go undocumented because hotel personnel are too busy to fill out the proper paperwork or are just dishonest. Oftentimes, the hotel employees handling this task are low level employees who may not be motivated, interested, or do not have the time, desire, or honesty to follow the established rental procedures. For most hotels providing audio visual services to its clientele, the third party provider cannot cost justify placing one of its employees in a small to medium sized hotel to capture all the rental transactions. Thus, the third party provider loses out on many legitimate dollars of rental income each year.

In one embodiment of the invention, the rental activity from each Unmanned Rental Site 106 is reported to Central Rental Processing Center 102 on a periodic basis. Each Unmanned Rental Site 106 has a computer system that monitors rental activity and monitors the available inventory list and tracks the rented, or

checked out, inventory and may automatically generate invoices for items rented. Invoices are typically generated upon the return of the equipment, but could also be generated at other times. The automated invoices may be sent to the client at each Unmanned Rental Site 106 and posted to an accounting system resident on a computer system located in Central Rental Processing Center 102. Exception reports generated in each Unmanned Rental Site 106 are also uploaded to Central Rental Processing Center 102 for analysis and action.

FIG. 2 shows a schematic layout diagram of an embodiment of an automated unmanned rental station located at an unmanned rental site of the present invention with application in the hotel industry. Referring now to FIG. 2, Automated Unmanned Rental Station 200, which may be a storage room or some type of secure space, is located in a hotel. The audio visual equipment stored in Automated Unmanned Rental Station 200 may be owned by a third party who has a contractual relationship with the hotel to supply audio visual equipment for use by the hotel staff or clientele of the hotel. The hotel may choose to store other items along with the audio visual equipment in Automated Unmanned Rental Station 200.

Typically, Storage Shelves 202 provide a safe and convenient way to store the audio visual equipment when not in use. Typical of the kinds of audio visual equipment made available to the hotel by the third party include, but are not limited to, Large Screen Television 204, Television Monitors 206, VCRs 208,

Microphones 210, and Overhead Projectors 212. Other types of audio visual equipment not shown include, but are not limited to, movie projectors and screens, portable public address systems, clip on microphones, slide projectors, video projectors, flip charts, etc. Each of the primary pieces of audio visual equipment has an RFID tag affixed thereto (not shown).

Computer System 214, more fully described below in the discussion of FIG. 3, controls an RFID tracking system that utilizes the RFID tags on each piece of audio visual equipment in cooperation with Antennas 216. Antennas 216 send and receive Signals 218 that interact with the RFID tags when the equipment containing the RFID tag passes through Portal 220. In one embodiment of the invention, a passive RFID system is used. One skilled in the art will recognize that an active RFID system could also be used.

Portal 220 may be a doorway, a gate, or a pass through opening. Antennas 216 may be any of the common types well known in the art. Antennas 216 may be located in a number of different positions around Portal 220 depending upon their type and the dimensions of Portal 220. Typically, for a doorway such as Portal 220, at least one Antenna 216 is located above Portal 220 (not shown in FIG. 2), and at least one Antenna 216 is located parallel to Portal 220 as is well known in the art. Depending upon the size and shape of Portal 220, one or more Antennas 216 are deployed in such a way as to provide complete coverage to Portal 220.

Each RFID tag contains unique data embedded in the passive RFID tag. As each piece of audio visual equipment having an RFID tag passes through Portal 220, the antenna powers the passive RFID tag, and the unique data contained in the passive RFID tag is emitted in a signal that is received by the antenna and transferred to Computer System 214. The transfer may be accomplished through a wired or wireless connection (not shown in FIG. 2) to Computer System 214. Computer System 214 interprets the signal, extracting the unique data. In one embodiment, the unique data embedded in the passive RFID tag includes a twelve digit number plus additional data written onto the tag. Computer System 214 then compares the number to an inventory database stored in Computer System 214 that maps each unique twelve digit number to each piece of audio visual equipment. The inventory database contains pertinent information in various database fields on each piece of audio visual equipment with the passive RFID tag that is assigned to this particular Unmanned Rental Site 106. Such information may include, but is not limited to, generic name for the piece of audio visual equipment, manufacturer, model number, serial number, color, dimensions, weight, date of acquisition, the vendor the piece of audio visual equipment was purchased from, repair and maintenance information, number of times rented, dates of past rentals, rental rate, barcode number, etc.

Computer System 214 has a user interface to allow for associating equipment rental activity with a user and a reference

document. The user in this embodiment is an authorized hotel employee. The user interface may be through a keyboard, a mouse, a voice command interpreted through speech recognition, a barcode reader such as a barcode wand, a touch screen of a graphics display, or any other suitable user interface. The user interface may also consist of any combination of two or more of the above mentioned interfaces.

Computer System 214 also employs a user identification process, which may be implemented in a number of different ways depending upon the requirements of the application. The user identification process may include, but is not limited to, facial recognition, retinal scan, palm scan, fingerprint reader, RFID tag issued to authorized personnel, password protection, swipe card, standard key, etc., or a combination of two or more of these options. Shown in FIG. 2 is User Identification Device 222, which may be a card reader or other suitable device associated with one of the above mentioned user identification processes.

The equipment rental software running on Computer System 214 establishes the business parameters of the processes used based on the application. A reporting hardware/software component may automatically communicate equipment movements to hotel contact personnel and to Central Rental Processing Center 102 (FIG. 1). An automated billing software component may create invoices from the daily activity data captured by Computer System 214. This information may be transmitted to both the hotel

contact personnel and Central Rental Processing Center 102. The invoices may also be printed out on paper and mailed to the hotel contact personnel. A security alarm software component may trigger an audible alarm under defined circumstances, such as a piece of audio visual equipment being removed from Automated Unmanned Rental Station 200 by an unauthorized individual. The audible alarm may sound through the built in speaker in Computer System 214, or through an external Alarm 224 as shown in FIG. 2.

When one or more pieces of audio visual equipment are needed, a hotel employee (authorized user) enters Automated Unmanned Rental Station 200 and logs onto the Computer System 214 utilizing the user identification process. In the embodiment shown in FIG. 2, the authorized user would access User Identification Device 222 in a manner appropriate for the device. For example, if User Identification Device 222 is a card reader, the authorized user would swipe an access card across User Identification Device 222. The authorized user then enters a reference number into the system utilizing the user interface. In one embodiment, the monitor of Computer System 214 has a touch sensitive display screen for user input. The reference number in this embodiment may be a banquet equipment order (BEO) for a hotel client. In other embodiments the reference number may be a job number, rental order number, purchase order number, tool crib request number, etc. The authorized user then enters the estimated number of days the equipment is to be used. Upon successfully entering the above

information, the alarm system is turned off and an indication is given to the authorized user that it is okay to remove equipment from Automated Unmanned Rental Station 200.

The authorized user then moves the equipment needed through Portal 220. The RFID tracking system receives the signal from the RFID tag on each piece of audio visual equipment moved through Portal 220. The equipment rental software interprets the received signal to acquire the unique data embedded on the RFID tag, and accesses the information stored in the inventory database for the piece of the audio visual equipment associated with the unique data. This information, along with the reference number, a date/time stamp, and the user who moved the equipment, is used to create a rental transaction record.

The current and any subsequent rental transactions may be automatically transmitted to the hotel contact personnel and/or Central Rental Processing Center 102 upon each occurrence, or in a batch at a specified time each day, or on one or more specified days of each week or month, via Communications Medium 104. Various reports may also be transmitted including, but not limited to, inventory status, equipment rental charges, reference numbers, identities of authorized users removing and returning equipment, and date and time the equipment was removed or returned to Automated Unmanned Rental Station 200.

Should equipment be moved through Portal 220 without proper process, then the alarm system would sound an audible alarm through Alarm 224, and the equipment rental software would

immediately download data in an exception report to the hotel contact personnel or Central Rental Processing Center 102 or both via an e-mail or a facsimile transmission. The equipment rental software may also issue a digital pager message or cellular telephone text message to one or more designated individuals, such as security personnel or other management personnel. Exception reports may also be issued if equipment is not returned by the time indicated when checked out, or when an RFID signal is not recognized, as well as when equipment is removed or returned without proper authorization.

The equipment rental software may also transmit daily inventory information to the hotel contact personnel. When requests for audio visual equipment come in throughout the day the hotel contact personnel can know whether or not they can fulfill the request.

At Central Rental Processing Center 102 (FIG. 1), the automated invoices are posted to an accounting software system, and invoices may be e-mailed, faxed, or printed and mailed, to the hotels if not already done so by each Unmanned Rental Site 106. Personnel at Central Rental Processing Center 102 may also review generated e-mails and exception reports generated to help resolve any problems. Telephone calls may be made to those hotel contact personnel who have outstanding equipment or who have had alarm notifications or exception reports. Examples of exception reports include unauthorized removal or return of equipment, equipment not recognized by its RFID unique data, and equipment

that is not returned by the date indicated that it was supposed to be returned when it was originally checked out. A single individual at Central Rental Processing Center 102 may manage a significant number of Unmanned Rental Sites 106 with a high dollar volume of sales at a very low cost.

FIG. 3 shows a schematic/block diagram of the computer system of FIG. 2. The computer system may be a mainframe computer system, a stand alone personal computer system, or a networked distributed computer system. The computer system shown in FIG. 3 is an exemplary embodiment.

Referring now to FIG. 3, Computer System 214 contains a Processing Element 302. The Processing Element 302 communicates to other elements of the Computer System 214 over a System Bus 304. A Keyboard 306 allows a user to input information into Computer System 214, and a Graphics Display 310 allows Computer System 214 to output information to the user. Graphics Display 310 may also have a touch sensitive display screen, allowing a user to input information into Computer System 214 through the touch screen of the graphics display. A pointing device, such as Mouse 308, is also used to input information. A Storage Device 312 is used to store data and programs within Computer System 214.

A Memory 316, also attached to System Bus 304, contains an Operating System 318, and Equipment Rental Software 320, which may have various modules such as, but not limited to, User Interface Module 322, User Identification Module 324, Reporting

Module 326, Automated Billing Module 328, Security Alarm Module 330, RFID Tracking Module 332, Communication Module 334, and Inventory Database Module 338.

User Interface Module 322 controls the interaction between the user and Equipment Rental Software 320. User Identification Module 324 controls the interaction between the identification hardware devices, such as User Identification Device 222, and Equipment Rental Software 320. Valid user identification input translates to a User ID Number that is unique for each authorized user. The User ID Number is associated with the rental transaction. Reporting Module 326 outputs reports regarding equipment rental activity, such as inventory status, equipment rental charges, reference numbers, identities of authorized users removing and returning equipment, and date and time the equipment was removed or returned. Automated Billing Module 328 may create invoices from the daily equipment rental activity. Security Alarm Module 330 controls the Alarm 224. RFID Tracking Module 332 interprets the signals received from the Antennas 216 for input to Equipment Rental Software 320.

Communications Module 334 controls Communications Interface 314, which is also attached to System Bus 304. Communications Interface 314 may have one or more serial ports, parallel ports, infrared ports, and the like. Connectable through Communications Interface 314 is User Identification Device 222, Alarm 224, and Antennas 216 (not shown in FIG. 3). Also connectable through Communications Interface 314 may be an external printer or

scanner, as well as access to a computer network or to the Internet (not shown in FIG. 3). A security device may also be connected to System Bus 304, such as ID Security Device 336. ID Security Device 336 may be a biometric device, a camera, a fingerprint or hand reader, a swipe card reader, or any other suitable security device.

FIGS. 4A through 4G together form a flow chart that shows a method of an embodiment of a computer system at an automated unmanned rental station of an automated unmanned rental system of the present invention. Referring now to FIG. 4A, in step 400 Equipment Rental Software 320 (FIG. 3) is loaded onto Computer System 214 in Automated Unmanned Rental Station 200 (FIG. 2). Upon loading, the various modules of Equipment Rental Software 320 activate the various systems and hardware, including the RFID tracking system, the security alarm system, the identification system, etc. The third party provider has prior to this time stocked Automated Unmanned Rental Station 200 with various pieces of audio visual equipment as shown in FIG. 2, each equipped with an RFID tag. Inventory Database Module 338 contains the information corresponding to each unique data derived from each RFID tagged piece of equipment located in Automated Unmanned Rental Station 200. Inventory Database Module 338 stores in an organized and structured fashion the individual data elements entered by the users, the system administrators, and by the interaction of the hardware and software as RFID tags are passed through the portal. The data is organized to allow

Equipment Rental Software 320 to store when RFID tags are passed through the portal, and then allow Equipment Rental Software 320 to calculate the time period between RFID reads. The structure of the data also facilitates the generation of reports by Reporting Module 326, by allowing specific individual data elements to be referenced.

In step 402 the User Interface Module 322 displays a "Begin Transaction" screen on Graphics Display 310 (FIG. 3). Graphics Display 310 in one embodiment of the invention has a touch sensitive display screen allowing for user input through the touch screen.

In determination step 404, Equipment Rental Software 320 determines if one of three types of input is received. If RFID input from the RFID tracking system is received, then control flows to step 482 of FIG. 4E, which is discussed below. If user input for shut down is received, then Equipment Rental Software 320 shuts down and the method of the present invention ends. If touch screen input to begin is received, then in step 408 a request for user identification is displayed on Graphics Display 310. In step 410, user identification input is received via User Identification Device 222, which is translated into a User ID Number. As mentioned earlier, other user identification devices may send input in step 410. Step 412 determines if the identification input is valid. If the identification input is not valid, then step 414 determines if this is the first or second attempt at identification input. If it is the first

attempt, then in step 416 a message is displayed on Graphics Display 310 indicating that the identification input received was invalid, and requests that the user try again. Control then returns to step 410 to receive the next user identification input. If step 414 determines that this is the second failed attempt at identification input, then in step 418 an unauthorized access attempt message is displayed on Graphics Display 310. In step 420 Equipment Rental Software 320 generates a date and time stamped exception report and automatically e-mails the exception report to the hotel contact personnel at the Unmanned Rental Site 106 and to Central Rental Processing Center 102. Control then returns to step 402 where User Interface Module 322 displays the "Begin Transaction" screen on Graphics Display 310.

If step 412 determines that the identification input received in step 410 is valid, then control flows to step 422 of FIG. 4B. Step 412 is typical of a check step of user input. For the most part in the rest of the flow chart of FIGS. 4A-4G, check steps are omitted for the sake of simplicity. One skilled in the art will recognize that the use of check steps for user input is well known in the art and would be used wherever appropriate in Equipment Rental Software 320.

Referring now to FIG. 4B, in step 422, which flows from step 412 of FIG. 4A, a message is displayed on Graphics Display 310 requesting the user to select "Logon", "Return Equipment", "Check-Out Equipment", "Edit Transaction", "Logoff", or "Reboot." The "Logon", "Edit Transaction", "Logoff", and

"Reboot" options are not shown in FIG. 4B. The "Logon", "Logoff", and "Reboot" options are well known in the art. The "Edit Transaction" option, also not shown, allows the user to add or change information to a previously entered transaction.

After the select option message is displayed, in step 422 a countdown timer is started for a predetermined period of time during which the user is allowed to respond. Typically, this predetermined period of time is between three to ten minutes, and may be adjusted in system set up. User input may be received in step 424. Step 426 determines if user input was received, and if so, if the user input was "Logon", "Return Equipment", "Check-Out Equipment", "Edit Transaction", "Logoff", or "Reboot." If step 426 determines that no user input has been received, then step 428 checks the countdown timer. Step 430 compares the countdown timer to the predetermined period of time allowed for user response. If step 430 determines that time has not expired, control returns to step 424 to receive user input. If step 430 determines that time has expired, then step 432 checks to see if the alarm has been triggered and is currently sounding. Such a situation arises when RFID input is received in step 404 and control flows to FIG. 4E, then returns to FIG. 4A at step 412, and then flows to FIG. 4B. This is further explained in the discussion of FIG. 4E below.

If the alarm has not been triggered, then control flows to step 402 of FIG. 4A, where User Interface Module 322 displays the "Begin Transaction" screen on Graphics Display 310. If step 432

determines that the alarm has been triggered, then in step 434 Equipment Rental Software 320 generates a date and time stamped exception report and automatically e-mails the exception report to the hotel contact personnel at the Unmanned Rental Site 106 and to Central Rental Processing Center 102. Control then also flows to step 402 of FIG. 4A.

If step 426 determines that "Return Equipment" input was received in step 424, then step 436 checks to see if the alarm has been triggered and is currently sounding. Such a situation arises when RFID input is received in step 404 and control flows to FIG. 4E, then returns to FIG. 4A at step 412, and then flows to FIG. 4B. This is further explained in the discussion of FIG. 4E below.

If the alarm was not triggered when the "Return Equipment" input was received, which is the case when touch screen input is received in step 404, then control flows to step 464 of FIG. 4D which is discussed below. If step 436 determines that the alarm was triggered when the "Return Equipment" input was received, then control flows to step 516 of FIG. 4G, which is discussed below.

If step 426 determines that "Check-Out Equipment" input was received in step 424, then in step 438 a request for input of a reference number message is displayed on Graphics Display 310. Step 440 receives the reference number input. The user may enter more than one reference number if the user is removing equipment for more than one client. A check step for the

validity of the reference number user input(s) is not shown in FIG. 4B.

In step 442, a message requesting input of the number of days the equipment is to be checked out is displayed on Graphics Display 310. Step 444 receives the number of days input. A check step for the validity of the number of days user input is not shown in FIG. 4B.

Step 446 checks to see if the alarm has been triggered and is currently sounding. Such a situation arises when RFID input is received in step 404 and control flows to FIG. 4E, then returns to FIG. 4A at step 412, and then flows to FIG. 4B. This is further explained in the discussion of FIG. 4E below.

If the alarm was triggered when the "Check-Out Equipment" input was received, then control flows to step 502 of FIG. 4F which is discussed below. If step 446 determines that the alarm was not triggered when the "Check-Out Equipment" input was received, which is the case when touch screen input is received in step 404, then in step 448 the alarm system is deactivated for a predetermined period of time to allow the authorized user to remove audio visual equipment from Automated Unmanned Rental Station 200. Typically this predetermined period of time is between three to ten minutes, and is adjustable in system set up. An okay to remove equipment message is displayed on Graphics Display 310. Control then flows to step 450 of FIG. 4C.

If step 426 determines that "Edit Transaction" input was received in step 424 (not shown in FIG. 4B), then a list of the

most recent transactions are displayed on Graphics Display 310. The user may then scroll down the list and select the transaction to be edited, make additions or changes, and save the transaction. The user may then logoff of the system or access any of the other functions of the system available at that point.

Referring now to FIG. 4C, in step 450, which flows from either step 448 of FIG. 4B or step 514 of FIG. 4F, a first RFID input signal is received by Antennas 216 as the first/next piece of audio visual equipment is removed from Automated Unmanned Rental Station 200 by the authorized user through Portal 220. Step 452 determines if the unique data interpreted from the RFID input signal is valid. For example, an invalid RFID input would occur if the third party provider delivered a new piece of equipment to the hotel for inclusion in their inventory, and the third party provider failed to update Inventory Database Module 338 through Equipment Rental Software 320 at the Unmanned Rental Site 106. Then, if that piece of equipment is removed from Automated Unmanned Rental Station 200, the unique data interpreted from the RFID input signal received by the RFID tracking system as it passed through Portal 220 would not match with any piece of equipment in the inventory database. Another example of invalid RFID input would occur if Inventory Database Module 338, when queried by Equipment Rental Software 320, indicates that a piece of equipment just removed is not supposed to be available in inventory, because its previous status is "checked out" and no record of it's status ever being changed to

"checked in" was recorded. A defective or damaged RFID tag may also result in an invalid RFID input or no input at all.

If step 452 determines that the RFID input is invalid, then in step 454 Equipment Rental Software 320 generates a date and time stamped exception report and automatically e-mails the exception report to the hotel contact personnel at the Unmanned Rental Site 106 and to Central Rental Processing Center 102. Control then returns to step 450 for receiving a next RFID input signal.

If step 452 determines that the RFID input is valid, then in step 456 a rental transaction record is created, pulling the data from the inventory database corresponding to the unique data interpreted from the RFID input signal received and associating the equipment with the proper reference number and User ID Number. The date and time of this event and the days the equipment is to be checked out is also captured, and the item's status in the inventory list in Inventory Database Module 338 is changed from "checked in" to "checked out." The rental transaction record may be automatically transmitted to a predetermined location, such as the hotel contact personnel and/or Central Rental Processing Center 102 upon each occurrence, or stored in Computer System 214 and then transmitted in a batch file at a specified time.

Step 458 then determines if another RFID input signal is received before the predetermined period of time has expired. If yes, then control returns to step 450. If step 458 determines

that the time period has expired, then in step 460 the alarm system is reactivated. In step 462 the User Interface Module 322 displays the "Begin Transaction" screen on Graphics Display 310. Control then flows to step 404 of FIG. 4A where Equipment Rental Software 320 determines if RFID input, touch screen input, or shut down input is received.

Referring now to FIG. 4D, step 464 flows from step 436 of FIG. 4B, where the alarm was not triggered or sounding when the "Return Equipment" input was received. In step 464 the alarm system is deactivated for a predetermined period of time to allow the authorized user to return audio visual equipment to Automated Unmanned Rental Station 200. Typical this predetermined period of time is between three to ten minutes, and is adjustable in system set up. An okay to return equipment message is displayed on Graphics Display 310.

In step 466 a first RFID input signal is received by Antennas 216 as the first piece of audio visual equipment is returned to Automated Unmanned Rental Station 200 by the authorized user through Portal 220. Step 468 compares the interpreted unique data from the RFID input signal received with the rental transaction records for the equipment in the inventory database whose status is "checked out." Step 470 determines if there is a match between the unique data interpreted from the RFID input signal and a piece of equipment in the inventory database whose status is "checked out." If step 470 determines that there is no match, then in step 472 Equipment Rental

Software 320 generates a date and time stamped exception report and automatically e-mails the exception report to the hotel contact personnel at the Unmanned Rental Site 106 and to Central Rental Processing Center 102. Control then returns to step 466 for receiving a next RFID input signal.

If step 470 determines that there is a match between the unique data received and a piece of equipment in the inventory database whose status is "checked out", then in step 474 an entry is made electronically into a log indicating the date and time the equipment was returned, and the equipment's status in the inventory list in Inventory Database Module 338 is changed from "checked out" to "checked in." Step 476 then determines if another RFID input signal is received before the predetermined period of time has expired. If yes, then control returns to step 466. If step 476 determines that the time period has expired, then in step 478 the alarm system is reactivated. In step 480 the User Interface Module 322 displays the "Begin Transaction" screen on Graphics Display 310. Control then flows to step 404 of FIG. 4A where Equipment Rental Software 320 determines if RFID input, touch screen input, or shut down input is received.

Referring now to FIG. 4E, step 482 flows from step 404 of FIG. 4A, where Equipment Rental Software 320 determined that RFID input has been received. In this situation, equipment has passed through Portal 220 without an authorized user first logging into the system. An authorized user may be returning equipment and passed through Portal 220 with the equipment and will soon be

logging into Equipment Rental Software 320. Or, an authorized user may be attempting to remove equipment and has forgotten to logon to Equipment Rental Software 320. Or, an unauthorized individual may be taking or returning equipment for valid or invalid reasons.

In step 482, the first unique data interpreted from the first RFID input signal received is stored. In step 484 Security Alarm Module 330 sends a triggering signal to activate Alarm 224 and begin a timed countdown to deactivate Alarm 224. Step 486 determines if touch screen input is received. If no touch screen input is received, then step 488 determines if the predetermined period of time has expired. If the predetermined period of time has not expired, control returns to step 486 to wait for touch screen input. If step 488 determines that the predetermined period of time has expired, the alarm is deactivated in step 489 and a check is done in step 490 to see if the stored interpreted unique data from the RFID input signal matches a piece of equipment in the inventory database whose status is "checked out." If there is no match, then step 491 checks to see if the stored interpreted unique data from the RFID input signal matches a piece of equipment in the inventory database marked as being in the inventory list. If not, control flows to step 493.

If a match is found in step 491, then in step 492 a rental transaction record is created, pulling the data from Inventory Database Module 338 corresponding to the unique data received. The status of the piece of equipment matching the

unique data is changed in the inventory list in Inventory Database Module 338 from "checked in" to "checked out." The rental transaction record may be automatically transmitted to a predetermined location, such as the hotel contact personnel and/or Central Rental Processing Center 102 upon each occurrence, or stored in Computer System 214 and then transmitted in a batch file at a specified time.

In step 493, flowing from either from step 491 or step 492, Equipment Rental Software 320 generates a date and time stamped exception report and automatically e-mails the exception report to the hotel contact personnel at the Unmanned Rental Site 106 and to Central Rental Processing Center 102.

Step 496 determines if more RFID input signals have been received. If yes, control returns to step 482 for storing the next interpreted unique data from the RFID input signal received. If step 496 determines that no more RFID input signals have been received, then control flows to step 402 of FIG. 4A where the User Interface Module 322 displays the "Begin Transaction" screen on Graphics Display 310.

If step 490 determines that the unique data stored matches a piece of equipment in the inventory database whose status is "checked out", then in step 494 an entry is made into a log indicating the date and time the equipment was returned, and the status of the equipment in the inventory list of Inventory Database Module 338 is changed to "checked in". Control then

flows to step 496 to determine if more RFID input signals have been received.

If step 486 determines that touch screen input is received, then step 498 displays a request for user identification message on Graphics Display 310. User identification input is received via User Identification Device 222 in step 500. Control then returns to step 412 of FIG. 4A to determine if the identification input is valid.

Referring now to FIG. 4F, step 502 flows from step 446 of FIG. 4B, where it was determined that the alarm was triggered when the "Check-Out Equipment" input was received. In step 502 the alarm system is deactivated for a predetermined period of time to allow the authorized user to remove audio visual equipment from Automated Unmanned Rental Station 200. Typically this predetermined period of time is between three to ten minutes, and is adjustable in system set up. An okay to remove equipment message is displayed on Graphics Display 310.

In step 504 the first RFID input signal stored since the alarm was triggered is interpreted. Step 506 determines if the interpreted unique data from the RFID input signal is valid. If it is not, then in step 508 Equipment Rental Software 320 generates a date and time stamped exception report and automatically e-mails the exception report to the hotel contact personnel at the Unmanned Rental Site 106 and to Central Rental Processing Center 102. Control then returns to step 504 where

the next RFID input signal stored since the alarm was triggered is interpreted.

If step 506 determines that the RFID input signal is valid, then in step 510 a rental transaction record is created, pulling the information from Inventory Database Module 338 corresponding to the unique data received. The date and time of this event is also captured, and the status of the item in the inventory list in Inventory Database Module 338 is changed from "checked in" to "checked out." Step 512 then determines if there are any more RFID input signals that have been stored. If yes, control returns to step 504 where the next RFID input signal stored since the alarm was triggered is interpreted.

If step 512 determines that there is no more stored RFID input signals, then step 514 determines if any new RFID input signals are received before the predetermined period of time has expired. If yes, then control returns to step 450 of FIG. 4C, where a next RFID input signal is received by Antennas 216 as the next piece of audio visual equipment is removed from Automated Unmanned Rental Station 200 by the authorized user through Portal 220. If step 514 determines that no new RFID input signals have been received before the time period has expired, then control returns to step 460 of FIG. 4C, where the alarm system is reactivated.

Referring now to FIG. 4G, step 516 flows from step 436 of FIG. 4B, where it was determined that the alarm was triggered when the "Return Equipment" input was received. In step 516 the

alarm system is deactivated for a predetermined period of time to allow the authorized user to return audio visual equipment to Automated Unmanned Rental Station 200. Typically this predetermined period of time is between three to ten minutes, and is adjustable in system set up. An okay to return equipment message is displayed on Graphics Display 310.

In step 518 the first RFID input signal stored since the alarm was triggered is interpreted and compared with the equipment in the inventory list in Inventory Database Module 338 whose status is "checked out." Step 520 determines if there is a match between the unique data from the RFID input signal received and a piece of equipment in Inventory Database Module 338 whose status is "checked out." If step 520 determines that there is no match, then in step 522 Equipment Rental Software 320 generates a date and time stamped exception report and automatically e-mails the exception report to the hotel contact personnel at the Unmanned Rental Site 106 and to Central Rental Processing Center 102. Control then flows to step 526.

If step 520 determines that there is a match between the unique data received and a piece of equipment in the inventory database whose status is "checked out", then in step 524 an entry is made into a log indicating the date and time the equipment was returned, and the equipment's status in the inventory list in Inventory Database Module 338 is changed from "checked out" to "checked in."

Flowing from either step 522 or 524, step 526 determines if there is any more RFID input signals that have been stored. If yes, control returns to step 518 where the next RFID input signal stored since the alarm was triggered is interpreted and compared with the equipment in the inventory database whose status is "checked out."

If step 526 determines that there are no more stored RFID input signals, then step 528 determines if any new RFID input signals are received before the predetermined period of time has expired. If yes, then control returns to step 466 of FIG. 4D, where a next RFID input signal is received by Antennas 216 as the next piece of audio visual equipment is returned to Automated Unmanned Rental Station 200 by the authorized user through Portal 220. If step 528 determines that no new RFID input signals have been received before the time period has expired, then control returns to step 478 of FIG. 4D, where the alarm system is reactivated.

FIG. 5 shows a schematic/block diagram of the computer system of a central rental processing center of FIG. 1 incorporating an embodiment of an automated unmanned rental system of the present invention. The computer system may be a mainframe computer system, a stand alone personal computer system, or a networked distributed computer system. The computer system shown in FIG. 5 is an exemplary embodiment.

Referring now to FIG. 5, Central Rental Processing Center Computer System 530 contains a Processing Element 532. The

Processing Element 532 communicates to other elements of the Central Rental Processing Center Computer System 530 over a System Bus 534. A Keyboard 536 allows a user to input information into Central Rental Processing Center Computer System 530, and a Graphics Display 540 allows Central Rental Processing Center Computer System 530 to output information to the user. Graphics Display 540 may also have a touch sensitive display screen, allowing a user to input information into Central Rental Processing Center Computer System 530 through the touch screen. A pointing device, such as Mouse 538, is also used to input information. A Storage Device 542 is used to store data and programs within Central Rental Processing Center Computer System 530.

A Memory 546, also attached to System Bus 534, contains an Operating System 548, Central Rental Processing Center Software 550, Database Module Software 551, Communication Software 552, and Reports Module Software 553. Central Rental Processing Center Software 550 controls the overall operation of Central Rental Processing Center Computer System 530. Database Module Software 551 stores in an organized and structured fashion the rental activity reported from each Unmanned Rental Site 106. Rental activity includes the individual data elements entered by the users, the system administrators, and by the interaction of the hardware and software as RFID tags are passed through the portal. The structure of the data also facilitates the generation of reports by Reports Module Software 553 by

allowing specific individual data elements to be referenced. Reports Module Software 553 accesses, but does not amend, delete, or alter, the data elements in Database Module Software 551. Reports Module Software 553 may generate reports that include, but is not limited to, inventory data, rental order data, and user lists. Reports Module Software 553 allows the users and system administrators to manage the overall system by pooling and grouping individual data elements into an organized format. Simultaneously, multiple individual data elements may be extracted as requested by the users or system administrators from Database Module Software 551 for display on Graphics Display 540 or printed out on paper.

Communication Software 552 controls a Communications Interface 544, also attached to System Bus 534. Communications Interface 544 may have one or more serial ports, parallel ports, infrared ports, and the like. Connectable through Communications Interface 544 may be an external printer or scanner, as well as access to a computer network or to the Internet (not shown in FIG. 5). Communication Software 552 and Communications Interface 544 enable Central Rental Processing Center Computer System 530 to link with one or more Unmanned Rental Sites 106 each having a Computer System 214.

FIG. 6 shows a flow chart of a method of a central processing rental center in an embodiment of an automated unmanned rental system of the present invention. Referring now to FIG. 6, in step 600 Central Rental Processing Center Software

550 is loaded onto Central Rental Processing Center Computer System 530 (FIG. 5) located in Central Rental Processing Center 102 (FIG. 1). In step 602, Central Rental Processing Center Computer System 530 begins receiving data via Communications Interface 544 from one or more Computer Systems 214 (FIG. 2) located at one or more Unmanned Rental Sites 106 (FIG. 1). This data includes daily rental activity and inventory status. Step 604 processes the data received and posts data, such as rental transactions and inventory status changes, to one or more subsystems. Subsystems may include, but are not limited to, an Accounting Subsystem and an Inventory Control Subsystem. The Accounting Subsystem, which in one embodiment of the invention is a separate computer package on a different computer system, may generate invoices once or more a month for the entire site. Inventory related data elements are combined for all remote locations in the Inventory Subsystem. The Inventory Subsystem allows reporting on a larger scale as compared to the Inventory Database Module 338 at each Unmanned Rental Site 106. The Inventory Subsystem may also allow for some manipulation of the data by administrators for management purposes.

In step 606, Central Rental Processing Center Software 550 may generate invoices for the rental activity if invoices are not generated at each Unmanned Rental Site 106. In step 608 Central Rental Processing Center Software 550 may generate inventory reports for each Unmanned Rental Site 106. In step 610

additional equipment having an RFID tag is entered into the inventory database and assigned to one of the Unmanned Rental Sites 106. The equipment will then be delivered to the Unmanned Rental Sites 106 as needed. In step 612 lost, stolen, or damaged equipment that is no longer suitable for renting is removed from the inventory database. Finally, in step 614, various management reports may be generated regarding various aspects of the rental activity associated with the Unmanned Rental Sites 106. The management reports may be run for each individual Unmanned Rental Site 106, combined by region, or system wide.

FIG. 7 shows a flow chart of a method of the billing process in an embodiment of an automated unmanned rental system of the present invention. Referring now to FIG. 7, in step 700 Equipment Rental Software 320 stores transaction data captured through rental activity, as described above, in a transaction data file. Periodically, in step 702, the stored transaction data file is transferred from Computer System 214 at an Unmanned Rental Site 106 to Central Rental Processing Center Computer System 530 at Central Rental Processing Center 102. This transfer is controlled by Communication Module 334 and corresponding Communication Software 552 loaded onto Central Rental Processing Center Computer System 530. In one embodiment of the invention, Communication Module 334 and the Communication Software 552 loaded onto Central Rental Processing Center Computer System 530 is a third party software product called Remote Ware by

Xcellenet. Any other suitable communications package may also be used.

In step 704 Central Rental Processing Center Software 550 accesses the transaction data file from the communication software for processing. For each transaction in the transaction data file, Central Rental Processing Center Software 550 determines in step 706 if there is any data missing associated with the transaction that would cause it to be an exception. If no, control flows to step 714. If yes, the transaction is extracted to an exception report in step 708. In step 710 a user resolves the problem transactions and secures the missing data, such as a valid User ID Number. This may entail making phone calls to the hotel contact personnel at the Unmanned Rental Site 106, or other appropriate means. Once resolved, in step 712 the user edits the exception report to reflect the corrected data for the transaction, and the edited exception report is returned for further processing by Central Rental Processing Center Software 550 in step 714.

In step 714 the transaction data is extracted to an edit list and reviewed by the user. The user determines in step 716 if each transaction has complete data. If yes, control flows to step 722. If not, in step 718 the edit list is printed for manual processing by the user. This may entail making phone calls to the hotel contact personnel at the Unmanned Rental Site 106, or other appropriate means. Once resolved, in step 720 the user enters any new data into the edit list that was missing, and the

edited list of transaction data is posted to a post processed data file in step 722. This data file is posted in step 724 to the accounting system software accounts receivables. The accounting system software may reside on Central Rental Processing Center Computer System 530 or on a different computer system. In step 726 invoices for each rental transaction are printed and mailed to the proper hotel, and the billing method of the present invention ends.

Having described different embodiments of the present invention, it will be understood by those skilled in the art that many changes in construction and circuitry and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the present invention, as defined in the claims. The disclosures and the description herein are intended to be illustrative and are not in any sense limiting of the invention, defined in scope by the following claims.